Supramolecular Chemistry-I

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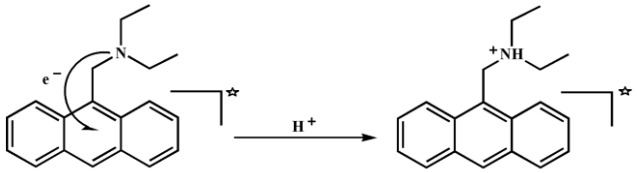
Lecture - 30

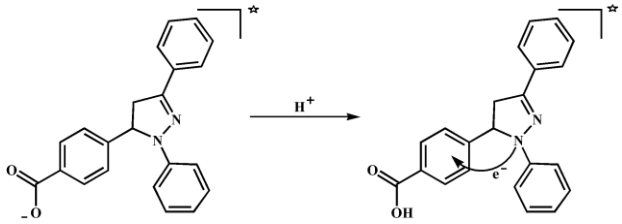
Welcome back to the class. So, in the previous class I talked about the concept of chemical computer. Chemical computer will be a very small device, it will be quite cheap. So, to make chemical computer what do we need? We need something called logic gates, and then we need the infrastructure, we need molecular wires amongst other things. Of course, we need molecular switch, molecular rectifiers i.e., molecular diodes, some of them have been realized. All these things come under molecular electronics. So this is a use of supra molecular chemistry in material science. So I will just touch upon some examples of logic gates and molecular wires and if time permits then I will talk about molecular rectifier also. So let us first discuss what is logic gates with examples. We shall use fluorescence because fluorescence is sensitive, fluorescence is quick and fluorescence can be selective also. So now let us see a molecular *[YES]* logic and when I say logic gates I have to talk about another thing, truth table, these are all there in the computers, Boolean algebra, truth table. So I will be giving you that what are truth table for a particular logic gate and so on and so forth. So first the simplest of logic, logic gates is yes logic. Usually when you write you have to write like an italic and all capital, *[YES]* logic. Here, when we add (input) nothing i.e., input =0 then PET will occur and no emission (output, 0). When we add (input) H^+ PET will not occur, so strong emission (output, 1). This is shown in the Truth Table on the right.



Truth Table

Input	Output
0	0
1	1

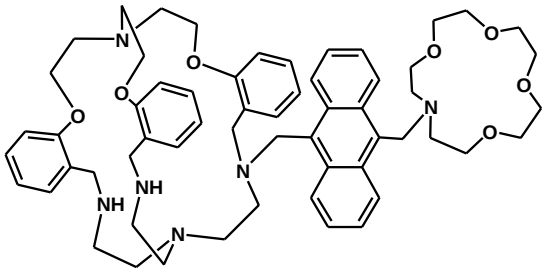
Another simple logic function is *[NOT]* logic: In this example, when we have carboxylate anion, i.e., electron rich and so PET is blocked and strong emission (output, 1) but when we add (input) H^+ it becomes carboxylic acid and now PET will occur (output, 0). This is reflected in the TRUTH Table.



Truth Table

Input	Output
0	1
1	0

Now, we can show an example of *[AND]* logic:

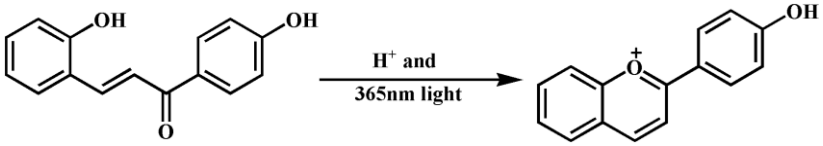


Here, Cu^{2+} and Na^{+} are the inputs.

Another example of the *[AND]* logic is shown below and the corresponding TRUTH Table is on the right:

Truth Table

Input 1	Input 2	Output
1	0	0
0	1	0
1	1	1

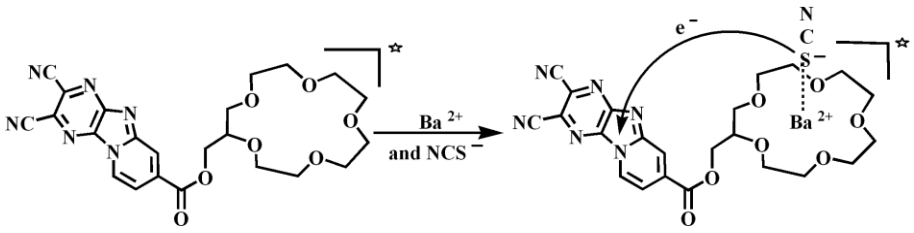


The *[AND]* logic gate is easy to understand. Say, my first input is Cu^{2+} that will go to inside the cavity of the cryptand. No Cu^{2+} will occupy the crown ether macrocycle. So, my input1 is Cu^{2+} (input1 is 1; input2 is 0) that will stop the PET from the cryptand; but the PET from the macrocycle is still on. So, output will be 0. If I put first Na^{+} ion (input2 is 1, input1 is 0) then my output again is 0. Because PET from the cryptand side will be on but it will be blocked from the macrocycle side. Now I put Cu^{2+} **and** Na^{+} (input1 is 1 and input2 is 1) then PET will be blocked from both sides. So, strong emissions will occur (output is 1). Truth Table is realized.

It need not be all chemicals. In the second example for *[AND]* logic gate, the two inputs are H^{+} and 365 nm light. If I put only H nothing happens, if I put only 365 nanometer

nothing happens that means input one is 1, input two is 0, nothing happens. Input one is 0, input two is 1, nothing happens but when input one is 1 that means input one is H^+ and input two is 360 nanometer light then the compound transforms to a new compound and that is very strongly fluorescent.

Now a *[NAND]* logic. NAND means NOT +AND. Let me draw



When the input is Ba^{2+} (input 1) and KSCN (input 2) then instead of showing *[AND]* logic gate, it shows output 0.

So, combine Truth Table can be written as:

Inputs		Output						
Input 1	**Input 2**	***AND***	***OR***	***NAND***	***NOR***	***INHIBIT***	***XOR***	***XNOR***
0	0	0	0	1	1	0	0	1
0	1	0	1	1	0	0	1	0
1	0	0	1	1	0	1	1	0
1	1	1	1	0	0	0	0	1